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WATER QUALITY INVESTIGATIONS, LAKE
MICHIGAN BASIN. POPULATION AND ECONOMY

Federal Water Pollution Control Administration
Chicago, Illinois

August 1967

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WATER QUALITY INVESTIGATIONS

LAKE MICHIGAN BASIN

POPULATION AND ECONOMY

A technical report containing background data
for a water pollution control program.

August 1967

UNITED STATES DEPARTMENT OF THE INTERIOR

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

Great Lakes Region

Chicago, Illinois

Reproduced by
NATIONAL TECHNICAL
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INTRODUCTION

This is one in a series of reports documenting background information for the development of a water quality control program for Lake Michigan and its drainage basin. For planning purposes the Lake Michigan Watershed has been subdivided into appropriate tributary drainage basins. For the purpose of projecting water uses and water-borne waste loads for these subbasins and in order to develop relationships among water uses, waste loads, population and economic development, information is needed on present conditions and past trends concerning population and economy.

For the economic analysis, the Lake Michigan Watershed was divided into 19 subregions of from 2 to 7 counties each and ranging in size from 795 to 4,166 square miles (Figure 1). Data from these subregions were used in making the aforementioned projections.

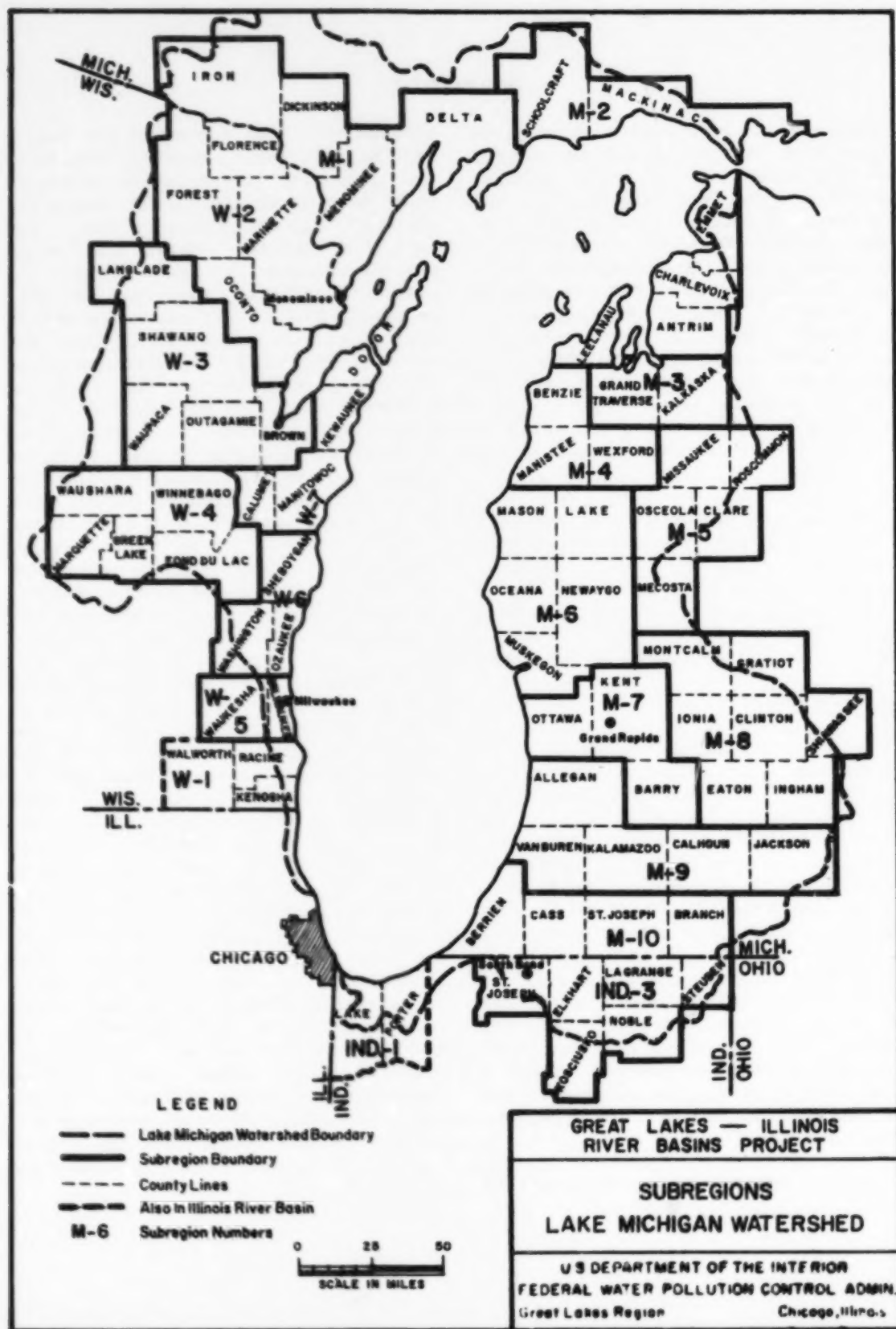
Basic Concepts

Two concepts used throughout this report need some definition or clarification -- "municipal" population and "value added by manufacture." To obtain a suitable measure of population growth from the standpoint of controlling and preventing water pollution, "municipal" population is considered as that population presently or likely to be served by municipal water supply and sewerage systems. To arrive at such an estimate, both the "urban" population of counties and the population of incorporated areas within counties were considered. Where a difference existed, the higher of the two figures was utilized and considered as municipal.

"Value added by manufacture" is

considered by the Bureau of the Census as "the best value measure available for comparing the relative economic importance of manufacturing among industries and geographic areas." For 1954 and earlier years, the measure was obtained by subtracting the cost of materials, supplies and containers, fuel, purchased electric energy, and contract work from the value of shipments for products manufactured plus receipts for services rendered. For 1958 an "adjusted value added" was obtained by taking into account the following items: a) value added by merchandising operations (that is, the difference between the sales value and cost of merchandise sold without further manufacture, processing, or assembly) plus b) the net change in finished goods and work-in-process inventories between the beginning and end of the year.

Historical employment data for 32 industry sectors for each county in the Watershed were prepared by the Office of Business Economics of the Department of Commerce. From the 32, industry sectors 5, 10, and 14 were selected as best approximating the major water-using industries -- sectors 5 and 10 are food and kindred products and chemicals and allied products, respectively. Sector 14 includes pulp and paper, primary metals, and petroleum and coal products. The net change in employment in these industries was computed for each economic subregion in the watershed for the 1940 to 1960 period. Information received at a later date enabled "breaking out" paper and allied products, petroleum and coal products and primary metals manufacturing, thus listing 35 rather than 32 industry sectors.



REGIONAL AND STATE TRENDS

To provide a background against which manufacturing trends as a whole in the Lake Michigan Watershed can be seen more clearly, data for selected States have been prepared. Table 1 indicates the trends in value added by manufacture in the five-state region comprised of Illinois, Indiana, Michigan, Ohio and Wisconsin. As the dollar values shown are not in constant dollars, they are expressed as a percent of the nation's total value added by manufacture during the years 1939, 1947, 1954, 1958, and 1962. This ratio analysis tends to eliminate the effect of changes in dollar values when comparing regional, state or other sub-regional trends.

As compared with national percentages, the five-state region declined slightly but steadily from 1939 to 1958. The trend for the State of Michigan was not consistent with the national trends - showing an increase from 1947 to 1954 and a substantial decline from 1954 to 1958. From 1947 to 1958, however, the trend in both the five-state region and in the State of Michigan was one of decline with the Michigan decline being more severe. Ohio showed a somewhat similar trend. Generally, however, the trend in all states from 1947 to 1958 (omitting 1954) was slightly downward, with minor declines in Indiana and Wisconsin and a sharp decline in Illinois.

The trends in total manufacturing employment (as a percent of the Nation) in the five-state area show great similarity to the trends in value added by manufacturing. Table 2 indicates that total manufacturing employment for the five-state region, after a slight increase from 1947 to 1954, declined sharply from 1954 to

1958. From 1947 to 1958 (omitting 1954), Michigan showed the largest decline, Illinois and Ohio showed substantial decline, the Indiana ratio was rather stable, and Wisconsin showed an increase.

The 1962 Annual Survey of Manufactures, which is based upon a representative sample of about 60,000 manufacturing establishments throughout the United States, provides information which should be considered in any appraisal of trends of manufacturing activity. Although the estimates obtained from this sample vary from totals that would be obtained from a canvass of all manufacturing establishments, they are sufficiently accurate for the formulation of judgments concerning trends in major regions or industry groups.

The 1962 five-state total of value added by manufacture as a percent of the Nation was about 29.2 percent as compared with about 29.0 percent in 1958, about 31.0 percent in 1954 and 31.5 percent in 1947. Generally, the trend from 1958 to 1962 was to reverse the slightly downward trend from 1947 to 1958. In summary, the five-state region tended basically to increase its industrial activity at about the national rate.

The five-state trend as shown in the 1962 figures was approximated by the Wisconsin, Indiana, and Michigan trends, with Michigan and Indiana showing the strongest tendencies to revert to earlier national proportions. Illinois continued to decline significantly and Ohio showed a minor gain. Generally, the same trends held in manufacturing employment.

TABLE 1

Value Added by Manufacture of Illinois, Indiana, Michigan, Ohio, and Wisconsin

1939, 1947, 1954, 1958, and 1962

State	1939		1947		1954		1958		1962	
	Value Added Million Dollars	% N	Value Added Million Dollars	% N	Value Added Million Dollars	% N	Value Added Million Dollars	% N	Value Added Million Dollars	% N
Illinois	2,201.6	9.0	6,683.1	9.0	9,663.8	8.2	11,665.1	8.2	13,670.9	7.6
Indiana	970.2	4.0	2,970.0	4.0	4,632.0	3.9	5,478.1	3.9	7,094.0	4.0
Michigan	1,789.4	7.3	5,200.1	7.0	8,707.2	7.4	8,363.6	5.9	11,969.2	6.7
Ohio	2,125.5	8.7	6,358.0	8.6	10,154.4	8.6	11,472.5	8.1	14,577.7	8.1
Wisconsin	686.6	2.8	2,171.8	2.9	3,198.2	2.7	3,959.5	2.8	5,100.2	2.8
5 State Total	7,782.3	31.3	23,383.0	31.5	36,355.6	31.0	40,937.8	29.0	52,412.0	29.2

Note: % N is the percent of the nation's total value added by manufacture.

Source: 1958 Census of Manufactures;
1962 Annual Survey of Manufactures.

TABLE 2
Total Manufacturing Employment of Illinois, Indiana, Michigan, Ohio, and Wisconsin
1939, 1947, 1954, 1958, and 1962

State	1939		1947		1954		1958		1962	
	Mfg. Empl. (1,000)	% N	Mfg. Empl. (1,000)	% N	Mfg. Empl. (1,000)	% N	Mfg. Empl. (1,000)	% N	Mfg. Empl. (1,000)	% N
Illinois	759.7	7.5	1,186.1	7.8	1,222.4	7.6	1,186.8	7.4	1,194.1	7.1
Indiana	340.6	3.4	548.3	3.6	587.3	3.6	550.9	3.4	596.7	3.6
Michigan	621.2	6.2	975.5	6.4	1,056.5	6.6	880.4	5.5	936.6	5.6
Ohio	735.3	7.3	1,194.3	7.8	1,292.6	8.0	1,196.1	7.5	1,222.6	7.3
Wisconsin	254.6	2.5	405.9	2.6	439.2	2.7	438.6	2.7	469.7	2.8
5 State Total	2,711.4	26.9	4,310.1	28.2	4,598.0	28.5	4,252.8	26.5	4,419.7	26.3

Note: % N is the percent of the Nation's total manufacturing employment.

Source: 1958 Census of Manufactures;
1962 Annual Survey of Manufactures.

Regional and state population trends from 1940 to 1960 are shown in Table 3. The total five-state population trend from 1940 to 1960 showed little change as a percent of the Nation, remaining at about 20 percent. The State of Michigan trend, however, has been to increase as a percent of the Nation even during the 1950 to 1960 decade. In contrast, Illinois declined as a percent of the Nation.

Trends in specific major water using industries are indicated in Tables 4 to 8.

TABLE 3

Population of Illinois, Indiana, Michigan, Ohio and Wisconsin

1940-1960

State	<u>1940</u>	<u>1/</u>	<u>1950</u>	<u>1/</u>	<u>1960</u>	<u>1/</u>
	Population (1,000)		Population (1,000)		Population (1,000)	
Illinois	7,897.2	6.0	8,712.2	5.7	10,081.2	5.6
Indiana	3,427.8	2.6	3,934.2	2.6	4,662.5	2.6
Michigan	5,256.1	4.0	6,371.8	4.2	7,823.2	4.4
Ohio	6,907.6	5.2	7,946.6	5.2	9,706.4	5.4
Wisconsin	3,137.6	2.4	3,434.6	2.3	3,951.8	2.2
5 State Total	26,626.3	20.2	30,399.4	20.0	36,225.1	20.2

1/ % N is the percent of the Nation's total population.

Source: 1960 Census of Population.

TABLE 4

FOOD AND KINDRED PRODUCTS
Value Added by Manufacture for Illinois, Indiana, Michigan, Ohio
Wisconsin, and Milwaukee SMSA 1/
1939, 1947, 1954, 1958, and 1962

State	1939		1947		1954		1958		1962	
	Value Added Million Dollars	$\frac{2}{\% N}$	Value Added Million Dollars	$\frac{2}{\% N}$	Value Added Million Dollars	$\frac{2}{\% N}$	Value Added Million Dollars	$\frac{2}{\% N}$	Value Added Million Dollars	$\frac{2}{\% N}$
Illinois	400.6	11.3	964.9	11.5	1,118.0	9.7	1,653.0	9.4	1,955.8	9.4
Indiana	109.5	3.1	271.8	3.2	318.5	2.8	501.3	2.9	640.2	3.1
Michigan	142.9	4.0	257.1	3.1	397.5	3.4	657.6	3.8	722.3	3.7
Ohio	186.3	5.2	376.1	4.5	535.0	4.6	871.6	5.0	1,053.3	5.0
Wisconsin	127.0	3.6	291.9	3.5	383.0	3.3	624.7	3.6	753.9	3.6
(Milwaukee SMSA)	N/A	N/A	198.4 3/	1.8	246.5	1.8	275.6	1.6	307.3	1.5
5 State Total	966.3	27.2	2,161.8	25.7	2,752.0	23.9	4,308.2	24.6	5,175.5	24.8

Note: 1/ Consists of Milwaukee and Waukesha Counties, Wisconsin.

2/ % N is the percent of the national total for the industry.

3/ Estimated as industry data not available for Waukesha County.

Source: Census of Manufactures 1939, 1954, 1958;
1962 Annual Survey of Manufactures.

TABLE 5

PAPER AND ALLIED PRODUCTS
Value Added by Manufacture for Illinois, Indiana, Michigan, Ohio,
Wisconsin, and Milwaukee SMSA ^{1/}

1939, 1947, 1954, 1958, and 1962

State	1939		1947		1954		1958		1962	
	Value Added Million Dollars	$\frac{2}{\% N}$	Value Added Million Dollars	$\frac{2}{\% N}$	Value Added Million Dollars	$\frac{2}{\% N}$	Value Added Million Dollars	$\frac{2}{\% N}$	Value Added Million Dollars	$\frac{2}{\% N}$
Illinois	56.3	6.5	158.1	5.4	229.4	5.0	287.0	5.0	365.6	5.0
Indiana	16.6	1.9	55.8	1.9	67.4	1.4	99.4	1.7	115.6	1.6
Michigan	56.4	6.5	174.3	6.0	236.1	5.1	259.9	4.6	336.0	4.8
Ohio	59.7	6.9	199.1	6.8	297.1	6.4	343.3	6.0	429.0	6.1
Wisconsin	62.4	7.2	188.7	6.5	317.8	6.9	402.7	7.0	490.7	6.9
(Milwaukee SMSA)	N/A	N/A	22.4 ^{3/}	.8	24.8.	.6	37.5	.6	46.9	.7
5 State Total	251.4	28.9	776.0	26.6	1,147.8	24.8	1,392.3	24.4	1,736.9	24.6

Note: ^{1/} Consists of Milwaukee and Waukesha Counties, Wisconsin

^{2/} % N is the percent of the national total for the industry.

^{3/} Estimated as industry data not available for Waukesha County.

Source: Census of Manufactures 1939, 1954, 1958;
1962 Annual Survey of Manufactures.

TABLE 6

CHEMICALS AND ALLIED PRODUCTS
Value Added by Manufacture for Illinois, Indiana, Michigan, Ohio,
Wisconsin and Milwaukee SMSA 1/
1939, 1947, 1954, 1958, and 1962

	1939		1947		1954		1958		1962	
State	Value Added Million Dollars	2/ \$ N	Value Added Million Dollars	2/ \$ N	Value Added Million Dollars	2/ \$ N	Value Added Million Dollars	2/ \$ N	Value Added Million Dollars	2/ \$ N
Illinois	144.6	7.7	438.3	8.2	663.7	7.0	847.8	6.9	1,048.3	6.5
Indiana	82.1	4.4	246.1	4.6	343.5	3.6	492.9	4.0	548.6	3.4
Michigan	121.0	6.4	281.7	5.3	497.0	5.2	593.9	6.8	678.4	4.2
Ohio	117.1	6.2	347.2	6.5	566.4	5.9	714.9	5.8	933.8	5.8
Wisconsin	21.8	1.2	49.2	.9	93.6	1.0	105.3	.8	150.4	.9
(Milwaukee SMSA)	N/A	N/A	21.7 3/	.4	29.8	.3	35.8	.3	N/A	N/A
5 State Total	486.6	25.9	1,362.5	25.6	2,164.2	22.7	2,754.8	22.4	3,359.5	20.9

Note: 1/ Consists of Milwaukee and Waukesha Counties, Wisconsin.

2/ \$ N is the percent of the national total for the industry.

3/ Estimated as industry data not available for Waukesha County.

Source: Census of Manufactures 1939, 1954, 1958;

1962 Annual Survey of Manufactures.

TABLE 7
PETROLEUM AND COAL PRODUCTS
Value Added by Manufacture for Illinois, Indiana, Michigan, Ohio,
and Wisconsin
1939, 1947, 1954, 1958, and 1962

State	1939		1947		1954		1958		1962	
	Value Added Million Dollars	% N	Value Added Million Dollars	% N	Value Added Million Dollars	% N	Value Added Million Dollars	% N	Value Added Million Dollars	% N
Illinois	57.4	8.5	162.1	8.1	214.6	9.6	208.3	8.3	231.0	6.5
Indiana	60.0	8.9	113.4	5.7	169.8	7.6	117.5	4.7	179.3	5.0
Michigan	14.3	2.1	50.2	2.5	67.8	3.0	50.7	2.0	74.6	2.1
Ohio	27.0	4.0	95.8	4.8	159.9	7.1	141.8	5.6	161.3	4.6
Wisconsin	N/A	N/A	9.3	.5	9.6	.4	10.9	.4	11.4	.3
5 State Total	N/A	N/A	430.8	21.6	621.7	27.8	529.2	21.0	657.6	18.5

Note: % N is the percent of the national total for the industry.

Source: Census of Manufactures 1939, 1954, 1958;
1962 Annual Survey of Manufactures.

TABLE 8

PRIMARY METAL INDUSTRIES
Value Added by Manufacture for Illinois, Indiana, Michigan, Ohio,
Wisconsin, and Milwaukee SMSA 1/
1939, 1947, 1954, 1958, and 1962

State	1939		1947		1954		1958		1962	
	Value Added Million Dollars	$\frac{2}{\% N}$	Value Added Million Dollars	$\frac{2}{\% N}$	Value Added Million Dollars	$\frac{2}{\% N}$	Value Added Million Dollars	$\frac{2}{\% N}$	Value Added Million Dollars	$\frac{2}{\% N}$
Illinois	325.0	11.0	556.3	9.7	817.6	8.2	906.9	7.8	1,125.2	8.1
Indiana	210.0	7.1	449.2	7.8	767.8	7.7	1,047.3	9.0	1,293.2	9.3
Michigan	189.8	6.4	427.2	7.4	674.0	6.8	683.1	5.8	1,081.8	7.8
Ohio	475.6	16.1	852.2	14.9	1,423.9	14.4	1,643.7	14.1	2,022.4	14.6
Wisconsin	69.9	2.4	130.0	2.3	189.6	1.9	213.9	1.8	291.2	2.1
(Milwaukee SMSA)	N/A	N/A	81.2 ^{3/}	1.4	121.4	1.3	139.6	1.2	179.8	1.3
5 State Total	1,270.3	43.0	2,414.9	42.1	3,872.9	39.1	4,494.9	38.5	5,813.7	42.0

Note: 1/ Consists of Milwaukee and Waukesha Counties, Wisconsin.

2/ % N is the percent of the national total for the industry.

3/ Estimated as industry data not available for Waukesha County.

Source: Census of Manufactures 1939, 1954, 1958;
1962 Annual Survey of Manufactures.

LAKE MICHIGAN WATERSHED

In 1960 approximately 5.7 million people lived in those counties of Michigan, Wisconsin, and Indiana which lie wholly or largely in the Lake Michigan Watershed - about twice the 1910 population. Over the next 60 years the number will likely more than double again to total approximately 13 million. The latter doubling from 5.7 million to 13 million, however, is numerically twice that of the 1910 to 1960 period. Although the past, and likely the future, rates of growth generally parallel the national rate, great differences exist within the Watershed. Some subregions, or county groupings have actually declined in population, e.g., parts of Upper Wisconsin and Upper Michigan. Others have experienced unusually rapid growth or large increases in total numbers. Some have experienced both; e.g., the Milwaukee area in Wisconsin increased from 470,000 in 1910 to 1,200,000 in 1960; the Michigan subregion which includes Kalamazoo, Battle Creek and Jackson increased from approximately 240,000 in 1910 to almost 550,000 in 1960. Some have shown even more rapid rates of increase. Present signs indicate that the metropolitan areas will continue to demonstrate these large increases in population. Problems of water supply and pollution control will also arise in smaller subregions which have had and are likely to continue to experience rapid growth rates.

It is also important to consider what is and will likely continue happening with respect to industry. Most projections for the United States as a whole indicate at least a sixfold increase in industrial activity during the next 60 years. For the most part, the Lake Michigan Watershed will share

in this growth, although, as in population, different subregions and industries will have varying growth both in rate and total volume. In 1958 value added by manufacture totaled \$5.6 billion in the Watershed - and this does not include that portion of the northwestern Indiana industrial complex which is partly within the area. In 1958, value added by manufacture in this Indiana area totaled \$1.3 billion. Large industrial subregions exist in both the Wisconsin and Michigan portions of the Watershed. Each State contributes about \$2.5 billion, with the Indiana subregion which contains South Bend accounting for the rest. The industry distribution pattern differs, however, with Wisconsin having its largest concentration of \$1.6 billion in the Milwaukee subregion and Michigan having four concentrations ranging from \$289 million to \$760 million. Although historical data for manufacturing activity is not as readily available as population data for counties and subregions, information for total manufacturing activity since 1947 is sufficient to point the way to likely future growth. Between 1947 and 1962 the dollar volume of value added by manufacture in Milwaukee County, expressed in 1957-1959 constant dollars, increased almost 60 percent. Several industrial concentrations in Michigan -- notably Muskegon, Kent, Ingham and several other counties -- also had both large volume and rapid growth rates between 1957 and 1962.

The industrial mix also differs considerably from state to state and subregion to subregion. Some of these industries are those which are usually labeled large water users, such as food and beverages, chemicals, paper

products and primary metals. Growth in these water using industries in the Watershed is expected to approximate national growth rates, but with some subregions growing at a faster or slower rate, depending upon such factors as resource availabilities, proximity to markets and other natural advantages or disadvantages. The availability of water in adequate quantity and quality is one of the major factors influencing growth.

Tables 9 through 21 show additional population and economic factors which are considered in the narrative statements that follow concerning specific economic subregions. The rather rapid growth for small areas does not necessarily imply corresponding increases in water use. Water reuse and related factors are developed in later chapters.

Tables 20 and 21 summarize the projected population and economic growth by subregions.

TABLE 9
Population and Area of the Lake Michigan Watershed
by Subbasin

<u>Subbasin</u>	<u>1960 Population</u>	<u>Area in Square Miles</u>
Boardman River and Traverse Bay Area	82,000	2,300
Betsie, Manistee, Pere Marquette, White and Minor Adjacent Streams	105,000	4,440
Muskegon River	192,000	3,250
Grand River	949,000	5,720
Kalamazoo River and Minor Adjacent Streams	446,000	2,490
St. Joseph River and Minor Adjacent Streams	766,000	5,260
Calumet Area	535,000	440
Milwaukee River and Minor Adjacent Streams	1,493,000	1,470
Sheboygan, Manitowoc and Sturgeon Bay Area	230,000	2,700
Fox River	509,000	6,370
Oconto, Peshtigo, Menominee and Minor Adjacent Streams	162,000	6,560
Escanaba, Whitefish, Sturgeon and Minor Adjacent Streams	39,000	2,190
Manistique River and Minor Adjacent Streams	13,000	2,310
Lake Michigan Watershed	5,521,000	45,500

TABLE 10

Lake Michigan Watershed
Subregions for Economic Analysis

<u>Subregions</u>	<u>Counties</u>	<u>Land Area Sq. Miles</u>
W-2	Florence, Forest, Marinette, Oconto*, Wisconsin	3,993
W-3	Brown, Langlade, Outagamie, Shawano*, Waupaca, Wisconsin	3,944
W-4	Fond du Lac, Green Lake, Marquette, Waushara, Winnebago, Wisconsin	2,618
W-5	Milwaukee, Waukesha, Wisconsin	795
W-6	Ozaukee, Sheboygan, Washington, Wisconsin	1,169
W-7	Calumet, Door, Kewaunee, Manitowoc, Wisconsin	1,726
M-1	Delta, Dickinson, Iron, Menominee, Michigan	4,166
M-2	Antrim, Charlevoix, Emmet, Leelanau, Mackinac, Schoolcraft, Michigan	3,914
M-3	Grand Traverse, and Kalkaska, Michigan	1,028
M-4	Benzie, Manistee, Wexford, Michigan	1,437
M-5	Clare, Mescosta, Missaukee, Osceola, Roscommon, Michigan	2,802
M-6	Lake, Mason, Muskegon, Nawaygo, Ocesna, Michigan	2,962
M-7	Barry, Kent, Ottawa, Michigan	1,975
M-8	Clinton, Eaton, Gratiot, Ingham, Ionia, Montcalm, Shiawasse, Michigan	4,090
M-9	Allegan, Calhoun, Jackson, Kalamazoo, Van Buren, Michigan	3,417
M-10	Berrien, Branch, Cass, St. Joseph, Michigan	2,082
IND-1**	Lake, Porter, Indiana	939
IND-3	Elkhart, Kosciusko, LaGrange, Noble, St. Joseph, Steuben, Indiana	2,572
W-1**	Walworth, Racine, Kenosha, Wisconsin	1,170

* Menominee County, formed from parts of Shawano and Oconto Counties, is not shown as census data not available.

** Also partially in Illinois River Basin.

TABLE 11

Population of Subregions of the Lake Michigan Watershed

Sub-region	1910	1940	1950		1960	
	Total (1,000)	Total (1,000)	Total (1,000)	Municipal (1,000)	Total (1,000)	Municipal (1,000)
W-2	71.6	79.3	75.1	30.6	70.7	29.5
W-3	185.0	246.3	272.3	167.0	316.5	213.9
W-4	158.8	180.4	196.3	126.2	220.4	143.7
W-5	470.2	829.6	956.9	856.0	1,194.2	1,139.0
W-6	95.8	123.6	137.9	87.3	171.0	110.8
W-7	97.2	115.0	124.3	60.0	136.5	73.3
M-1	91.4	107.8	100.7	62.1	100.1	62.9
M-2	82.0	66.2	67.7	28.2	68.9	28.0
M-3	31.9	28.0	33.2	19.0	37.9	20.5
M-4	58.1	44.3	45.4	26.8	45.3	28.6
M-5	59.5	51.1	56.5	19.4	60.3	23.3
M-6	104.9	152.8	185.0	110.0	217.8	125.6
M-7	227.0	328.6	388.3	272.0	493.6	357.4
M-8	234.5	329.1	392.7	240.6	468.3	292.0
M-9	243.4	364.3	442.1	273.4	546.7	353.4
M-10	125.3	168.5	209.2	113.4	264.0	135.4
IND-1	103.0	321.0	408.3	361.9	573.6	519.1
IND-3	214.6	314.9	380.2	261.3	448.6	300.9
W-1	120.0	190.6	226.4	153.2	294.8	196.1
Total	2,774.2	4,042.0	4,698.5	3,268.8	5,729.2	4,153.4

Source: Census of Population, 1910-1960.

TABLE 12

Population of Subregions of the Lake Michigan Watershed
1940-1960

Sub-region	1940		1950		1960	
	Population (1,000)	% 5-State Region	Population (1,000)	% 5-State Region	Population (1,000)	% 5-State Region
W-2	79.3	.30	75.1	.25	70.7	.20
W-3	246.3	.92	272.3	.90	316.5	.87
W-4	180.4	.68	196.3	.65	220.4	.61
W-5	829.6	3.12	956.9	3.15	1,194.2	3.30
W-6	123.6	.46	137.9	.45	171.0	.47
W-7	115.0	.43	124.3	.41	136.5	.38
M-1	107.8	.40	100.7	.33	100.1	.28
M-2	66.2	.25	67.7	.22	68.9	.19
M-3	28.6	.11	33.2	.11	37.9	.10
M-4	44.3	.17	45.4	.15	45.3	.12
M-5	51.1	.19	56.5	.19	60.3	.17
M-6	152.8	.57	185.0	.61	217.8	.60
M-7	328.6	1.23	388.3	1.28	493.6	1.36
M-8	329.1	1.24	392.7	1.29	468.3	1.29
M-9	364.3	1.37	442.1	1.45	546.7	1.51
M-10	168.5	.63	209.2	.69	264.0	.73
IND-1	321.0	1.20	408.3	1.34	573.6	1.58
IND-3	314.9	1.18	380.2	1.25	448.6	1.24
W-1	190.6	.72	226.4	.74	294.8	.81
Total	4,042.0	15.18	4,698.5	15.45	5,729.2	15.81

Note: 5-State region consists of Illinois, Indiana, Michigan, Ohio, and Wisconsin.

Source: 1960 Census of Population.

TABLE 13

Value Added by Manufacture of Subregions
of the Lake Michigan Watershed
(in 1957-1959 Constant Dollars)

Sub-region	1947		1954		1958	
	Value Added (\$1,000)	% 5 State Region	Value Added (\$1,000)	% 5 State Region	Value Added (1,000)	% 5 State Region
W-2	35,600	.12	51,400	.13	62,500	.15
W-3	173,000	.58	215,000	.54	278,000	.68
W-4	167,000	.56	218,000	.55	236,000	.58
W-5	1,300,000	4.33	1,630,000	4.11	1,720,000	4.21
W-6	143,000	.48	159,000	.42	203,000	.50
W-7	102,000	.34	126,000	.32	133,000	.33
M-1	39,700	.13	49,100	.12	48,300	.12
M-2	16,200	.05	17,600	.04	23,400	.06
M-3	7,700	.03	17,700	.04	14,500	.04
M-4	24,400	.08	34,800	.09	31,300	.08
M-5	7,400	.02	17,700	.04	16,800	.04
M-6	203,000	.67	217,000	.54	229,000	.56
M-7	417,000	1.39	617,000	1.55	569,000	1.39
M-8	309,000	1.03	475,000	1.19	417,000	1.02
M-9	507,000	1.68	712,000	1.79	760,000	1.86
M-10	184,000	.61	285,000	.72	289,000	.71
IND-1	641,000	2.56	1,070,000	2.70	1,280,000	3.13
IND-3	441,000	1.46	564,000	1.42	638,000	1.56
W-1	326,000	1.08	370,000	.93	405,000	.99
Total	5,040,000	17.20	6,850,000	17.24	7,350,000	17.98

Note: 5 State region consists of Illinois, Indiana, Michigan, Ohio and Wisconsin.

Source: Census of Manufactures 1954, 1958.

TABLE 14

Manufacturing Employment of Subregions of the
Lake Michigan Watershed, 1947-1958

Sub-region	1947 ^{1/}		1954 ^{1/}		1958 ^{1/}	
	Total	% 5 State Region	Total	% 5 State Region	Total	% 5 State Region
W-2	6,007	.14	6,018	.13	6,626	.16
W-	25,296	.59	26,744	.58	29,679	.70
W-4	24,236	.56	26,054	.57	26,578	.62
W-5	185,692	4.31	183,816	4.00	180,758	4.25
W-6	21,296	.49	21,403	.46	22,578	.53
W-7	14,094	.33	16,975	.37	16,340	.38
M-1	7,511	.17	7,814	.17	6,927	.16
M-2	2,492	.06	2,855	.06	2,933	.07
M-3	1,928	.04	2,510	.05	2,189	.05
M-4	5,098	.12	4,688	.10	3,783	.09
M-5	1,648 ^{2/}	.03	2,775	.06	2,496	.06
M-6	34,045 ^{3/}	.79	27,596 ^{4/}	.60	27,564	.65
M-7	61,635	1.43	66,429	1.44	58,714	1.38
M-8	43,094	1.00	45,864	1.00	39,101	.92
M-9	62,537	1.45	67,281	1.46	67,125	1.58
M-10	28,608	.66	31,501	.68	32,208	.76
IND-1	94,167	2.20	101,516	2.21	98,254	2.31
IND-3	65,026	1.51	67,345	1.46	61,503	1.45
W-1	42,299	.98	40,359	.88	39,540	.93
Total	727,509	16.87	749,543	16.31	724,896	17.04

^{1/} Consists of Illinois, Indiana, Michigan, Ohio and Wisconsin.

^{2/} Excludes Missaukee County, Michigan as data was not available.

^{3/} Excludes Lake County, Michigan as data was not available.

^{4/} Excludes Newaygo County, Michigan as data was not available.

Source: Census of Manufactures 1954, 1958.

TABLE 15

Value Added by Manufacture and Dollar Volume of
Wholesale, Retail and Selected Services Trades - 1958

<u>Subregion</u>	<u>Value Added By Manufactures</u> (\$1,000)	<u>Wholesale Trade</u> (\$1,000)	<u>Retail Trade</u> (\$1,000)	<u>Selected Services</u> (\$1,000)
W-2	62,708	29,340	67,466	5,056
W-3	278,120	405,036	362,820	33,308
W-4	236,038	141,346	251,439	22,150
W-5	1,722,420	2,500,480	1,345,276	223,980
W-6	203,473	89,160	161,950	14,026
W-7	133,595	60,185	126,709	11,343
M-1	48,314	74,984	107,539	8,617
M-2	23,440	28,030	77,677	12,262
M-3	14,545	28,277	50,856	4,591
M-4	31,327	23,586	49,708	4,072
M-5	16,770	22,477	61,427	5,014
M-6	229,315	127,639	222,680	17,997
M-7	569,219	793,432	558,054	72,470
M-8	417,215	433,167	543,026	43,719
M-9	760,597	455,614	614,445	62,672
M-10	289,162	177,287	290,111	27,821
IND-1	1,281,927	454,754	633,236	53,735
IND-3	638,801	570,506	533,895	59,354
W-1	405,875	161,311	322,782	34,294

Source: 1958 Census of Manufactures; 1958 Census of Business
Wholesale Trade, Retail Trade, and Selected Services.

TABLE 16

Value of Mineral Production and Value of Forest Products
1959

<u>Subregion</u>	<u>Value of Forest Products</u> ^{1/}	<u>Value of Mineral Production</u> ^{2/} (\$1,000)
W-2	\$ 337,839	\$ 379.4
W-3	643,671	2,324.7
W-4	101,289	3,610.6
W-5	8,394	6,071.9
W-6	40,319	1,482.7
W-7	164,778	285.7
M-1	526,432	22,636.6
M-2	208,643	10,583.5
M-3	56,436	129.1
M-4	96,189	12,657.4
M-5	287,920	6,311.1
M-6	303,053	3,242.8
M-7	248,738	5,809.9
M-8	551,037	5,322.9
M-9	327,100	8,358.3
M-10	167,897	1,722.2
IND-1	17,143	373.0
IND-3	253,949	1,873.2
W-1	34,619	1,924.0

^{1/} "On farm" production only.

^{2/} Information was not available for the following counties: Door, Florence, Marinette, Waupaca, Waushara, Wisconsin; Mackinac, Benzie, Mason, Gratiot, Michigan; and LaGrange, Indiana.

Source: Reprint from 1960 Minerals Yearbook; 1959 Minerals Yearbook; 1959 Census of Agriculture.

TABLE 17-A

1960 Population Densities of Counties of the Lake Michigan Watershed

<u>Subregion</u>	<u>County</u>	<u>Persons Per Square Mile</u>
W-2	Florence	7.0
	Forest	7.5
	Marinette	25.0
	Oconto	22.7
W-3	Brown	238.3
	Langlade	23.2
	Outagamie	160.6
	Shawano	29.2
	Waupaca	47.1
W-4	Fond du Lac	103.7
	Green Lake	43.4
	Marquette	18.6
	Waushara	21.5
	Winnebago	237.7
W-5	Milwaukee	4,334.9
	Waukesha	284.6
W-6	Ozaukee	163.6
	Sheboygan	170.9
	Washington	107.8
W-7	Calumet	70.7
	Door	42.1
	Kewaunee	55.2
	Manitowoc	127.7
M-1	Delta	29.1
	Dickinson	31.6
	Iron	14.4
	Menominee	23.9
M-2	Antrim	21.7
	Charlevoix	32.4
	Emmet	34.5
	Leelanau	26.7
	Mackinac	10.7
	Schoolcraft	7.5

TABLE 17-B

1960 Population Densities of Counties of the Lake Michigan Watershed (Cont'd)

<u>Subregion</u>	<u>County</u>	<u>Persons Per Square Mile</u>
M-3	Grand Traverse	72.2
	Kalkaska	7.8
M-4	Benzie	24.8
	Manistee	34.1
	Wexford	32.8
M-5	Clare	20.4
	Mecosta	37.4
	Missaukee	12.0
	Osceola	23.4
	Roscommon	13.8
M-6	Lake	9.3
	Mason	44.5
	Muskegon	297.5
	Newaygo	28.2
	Oceana	30.9
M-7	Barry	57.8
	Kent	421.3
	Ottawa	175.0
M-8	Clinton	66.5
	Eaton	87.6
	Gratiot	65.4
	Ingham	378.0
	Ionia	75.0
	Montcalm	50.3
	Shiawassee	99.0
M-9	Allegan	69.6
	Calhoun	195.9
	Jackson	187.2
	Kalamazoo	299.3
	Van Buren	79.7
M-10	Berrien	258.4
	Branch	69.0
	Cass	75.7
	St. Joseph	83.3

TABLE 17-C

1960 Population Densities of Counties of the Lake Michigan Watershed (Cont'd)

<u>Subregion</u>	<u>County</u>	<u>Persons Per Square Mile</u>
IND-1	Lake	998.6
	Porter	141.8
IND-3	Elkhart	228.2
	Kosciusko	75.0
	LaGrange	45.9
	Noble	68.7
	St. Joseph	511.0
	Steuben	55.4
W-1	Racine	420.7
	Kenosha	386.6
	Walworth	93.5

Source: 1960 Census of Population.

TABLE 18
Employment in Major Water-Using Industries ^{1/}
1940-1960

<u>Subregion</u>	<u>1940 Employment</u>	<u>1950 Employment</u>	<u>1960 Employment</u>
W-2	2,403	3,379	3,240
W-3	11,640	17,089	20,647
W-4	8,676	12,482	15,428
W-5	53,969	72,375	73,685
W-6	10,699	13,799	15,446
W-7	6,089	8,101	10,926
M-1	1,358	2,452	3,390
M-2	1,382	1,565	2,068
M-3	396	654	1,198
M-4	1,858	2,490	2,109
M-5	353	1,020	2,035
M-6	8,563	9,416	15,200
M-7	16,113	21,747	30,031
M-8	6,135	8,861	13,418
M-9	26,788	35,927	42,160
M-10	9,778	12,433	17,227
IND-1	56,892	74,586	87,034
IND-3	15,187	20,926	26,208
W-1	8,345	13,055	14,325
Lake Michigan Watershed	246,624	332,357	395,775

^{1/} Water using industries include Food and Kindred Products, Paper and Allied Products, Chemical and Allied Products, Primary Metal Industries, and Petroleum and Coal Products.

Source: Office of Business Economics, U. S. Dept. of Commerce.

TABLE 19-A

Major Water Using Industries in Subregions
of the Lake Michigan Watershed

<u>Subregion</u>	<u>Industry</u>	<u>Percent of Subregion's Total Manufacturing Employment - 1962</u>	<u>Number of Employees 1962</u>
Wisconsin			
W-1*	Food and Kindred Products	2.8	1,262
	Chemicals and Allied Products	4.8	2,200
	Primary Metal Industries	9.6	4,413
	Total	17.2	7,875
W-2	Food and Kindred Products	6.4	440
	Paper and Allied Products	35.3	2,250
	Total	39.7	2,690
W-3	Food and Kindred Products	17.2	4,820
	Paper and Allied Products	35.4	9,910
	Primary Metal Industries	2.1	590
	Total	54.7	15,320
W-4	Food and Kindred Products	10.0	2,950
	Paper and Allied Products	22.9	6,740
	Primary Metal Industries	3.6	1,070
	Total	36.5	10,760
W-5	Food and Kindred Products	10.8	20,130
	Paper and Allied Products	2.7	5,100
	Chemicals and Allied Products	1.6	2,900
	Primary Metal Industries	8.8	16,380
	Total	23.9	44,510

TABLE 19-B

Major Water Using Industries in Subregions
of the Lake Michigan Watershed - Cont'd

<u>Subregion</u>	<u>Industry</u>	<u>Percent of Subregion's Total Manufacturing Employment - 1962</u>	<u>Number of Employees 1962</u>
W-6	Food and Kindred Products	8.9	2,160
	Paper and Allied Products	2.7	660
	Chemicals and Allied Products	2.5	610
	Primary Metal Industries	3.1	750
	Total	17.2	4,180
W-7	Food and Kindred Products	10.0	1,800
	Paper and Allied Products	1.2	210
	Primary Metal Industries	5.2	940
	Total	16.4	2,950
Michigan			
M-1	Food and Kindred Products	5.9	410
	Paper and Allied Products	16.4	1,120
	Petroleum and Coal Products	2.5	180
	Primary Metal Industries	1.9	130
	Total	26.7	1,840
M-2	Paper and Allied Products	4.9	160
	Primary Metal Industries	5.3	180
	Total	10.2	340
M-3	Food and Kindred Products	19.6	400
	Total	19.6	400
M-4	Food and Kindred Products	6.7	280
	Paper and Allied Products	12.1	500
	Chemicals and Allied Products	10.8	450
	Primary Metal Industries	16.3	670
	Total	45.9	1,900

TABLE 19-C
Major Water Using Industries in Subregions
of the Lake Michigan Watershed - Cont'd

<u>Subregion</u>	<u>Industry</u>	<u>Percent of Subregion's Total Manufacturing Employment - 1962</u>	<u>Number of Employees 1962</u>
M-5	Food and Kindred Products	4.0	130
	Primary Metal Industries	5.5	180
	Total	9.5	310
M-6	Food and Kindred Products	7.2	2,020
	Paper and Allied Products	3.7	1,040
	Chemicals and Allied Products	3.3	930
	Petroleum and Coal Products	.7	200
	Primary Metal Industries	18.4	5,140
	Total	33.3	9,330
M-7	Food and Kindred Products	7.6	4,780
	Paper and Allied Products	1.6	980
	Chemicals and Allied Products	1.7	1,090
	Primary Metal Industries	4.3	2,720
	Total	15.2	9,570
M-8	Food and Kindred Products	4.0	1,833
	Paper and Allied Products	.2	80
	Chemicals and Allied Products	1.9	874
	Petroleum and Coal Products	1.4	640
	Primary Metal Products	5.7	2,580
	Total	13.2	6,010
M-9	Food and Kindred Products	14.8	10,230
	Paper and Allied Products	16.5	11,390
	Chemicals and Allied Products	4.8	3,350
	Primary Metal Industries	5.1	3,580
	Total	41.2	28,550

TABLE 19-D

Major Water Using Industries in Subregions
of the Lake Michigan Watershed - Cont'd

<u>Subregion</u>	<u>Industry</u>	<u>Percent of Subregion's Total Manufacturing Employment - 1962</u>	<u>Number of Employees 1962</u>
M-10	Food and Kindred Products	4.4	1,560
	Paper and Allied Products	10.0	3,520
	Primary Metal Industries	14.2	4,990
	Total	28.6	10,070
Indiana			
IND-1*	Food and Kindred Products	3.0	3,090
	Paper and Allied Products	.5	540
	Chemicals and Allied Products	2.7	2,790
	Petroleum and Coal Products	8.1	8,230
	Primary Metal Industries	61.9	63,100
	Total	76.2	77,750
IND-3	Food and Kindred Products	5.6	3,530
	Paper and Allied Products	2.5	1,570
	Chemicals and Allied Products	.6	380
	Primary Metal Industries	4.1	2,580
	Total	12.8	8,060

* Common to the Illinois River Basin.

Source: County Business Patterns, First Quarter 1962.

TABLE 20

Population Projections for Subregions
of the Lake Michigan Watershed

Subregion	1960		1980		2020	
	Total (1,000)	Municipal (1,000)	Total (1,000)	Municipal (1,000)	Total (1,000)	Municipal (1,000)
W-2	70.7	29.6	73	31	74	32
W-3	316.5	213.9	425	306	807	688
W-4	220.4	143.7	275	193	458	353
W-5	1,194.2	1,139.0	1,696	1,696	2,990	2,990
W-6	171.0	110.8	244	161	415	326
W-7	136.5	73.3	167	100	257	184
M-1	100.1	63.0	92	58	97	61
M-2	68.9	28.0	68	31	76	38
M-3	37.9	20.5	43	25	61	40
M-4	45.3	28.6	47	30	50	34
M-5	60.3	23.3	63	28	78	45
M-6	217.8	125.6	263	162	395	259
M-7	493.6	357.4	649	510	1,098	968
M-8	468.3	292.0	625	448	1,231	1,044
M-9	546.7	353.4	688	469	1,058	838
M-10	264.0	135.4	345	186	566	370
IND-1	573.6	519.1	1,020	975	1,700	1,700
IND-3	448.6	300.9	628	462	1,229	1,035
W-1	294.8	196.1	450	335	775	775
Lake Michigan Watershed	5,729.2	4,153.4	7,900	6,200	13,400	11,800

Source: 1960 Census of Population; GLIRB Project Projections.

TABLE 21

Projections of Population, Manufacturing
Employment and Employment Equivalent
Multipliers* 1960 to 1980 and 2020

Sub-region	1960		1980			2020		
	Popu- lation (1,000)	Mfg. Employ- ment (1,000)	Popu- lation (1,000)	Mfg. Employ- ment (1,000)	Employment Equivalent Multipliers X 1960	Popu- lation (1,000)	Mfg. Employ- ment (1,000)	Employment Equivalent Multipliers X 1960
W-2	70.7	6.8	73	7.3	1.71	74	7.4	4.1
W-3**	316.5	32.4	425	4.2	1.94	807	81	6.0
W-4	220.4	29.5	275	33	1.80	458	46	6.0
W-5	1,194.2	190.9	1,696	229	1.93	2,990	299	6.0
W-6	171.0	27.1	244	29	1.74	415	42	5.9
W-7	136.5	19.3	167	20	1.67	257	26	5.1
M-1	100.1	8.3	92	8.3	1.57	97	9.7	4.5
M-2	68.9	4.1	68	4.3	1.88	76	7.6	7.1
M-3	37.9	2.3	43	2.5	1.75	61	3.3	5.4
M-4	45.3	4.8	47	4.7	1.57	50	5.0	4.0
M-5	60.3	4.6	63	5.0	1.73	78	7.8	6.5
M-6	217.8	31.9	263	34	1.73	395	40	4.8
M-7	493.6	67.1	649	80	1.92	1,098	110	6.3
M-8	468.3	50.1	625	60	1.92	1,231	91	7.0
M-9	546.7	72.6	688	83	1.83	1,058	106	5.6
M-10	264.0	39.8	345	45	1.81	566	57	5.4
IND-1	573.6	99.4	1,020	148	2.40	1,700	170	6.6
IND-3	448.6	68.5	628	83	1.91	1,229	123	6.9
W-1	294.8	49.6	450	63	2.04	775	78	6.0

*Productivity increases from 1960 are expected to result in an equivalent or effective employment 1.6 times the actual employment by 1980 and 3.8 times actual employment by 2020; this equivalent employment is then divided by the 1960 actual manufacturing employment to obtain the multipliers shown.

**Discussion with industry officials in this subregion concerning future growth trends in the area's leading industry, paper making, have led to the use of somewhat lower productivity increases than those used in the other subregions of the watershed; multipliers of 1.5 times 1960 by 1980 and 2.4 times 1960 by 2020 were used in this subregion (e.g., $4.2 \times 1.5 = 32.4 = 1.94$ in 1980).

SUBREGIONS

W-2, Florence, Forest, Marinette, and Oconto Counties, Wisconsin

This four-county, 3,993 square mile economic subregion is the most northerly portion of Wisconsin lying in the Lake Michigan Watershed. Within the subregion are located the Peshtigo and Oconto River Basins and a portion of the Menominee River Basin.

The 1960 population of the subregion was 70,700. Dwindling population in each county of the subregion from 1940 to 1960 resulted in a total decrease of 8,600. About 40 percent of the population was municipal. This subregion, with only 18 persons per square mile, had next to the lowest population density of any subregion in the Watershed. Marinette City, with a 1960 population of 13,300, is the largest incorporated community in the subregion. Both Marinette County and Oconto County border on Green Bay.

Forest products, although declining, still are an important part of the area economy. Sales of crops, livestock, and livestock products produced in this subregion totaled \$21.5 million in 1959. Of this amount livestock and livestock products accounted for \$19.6 million and crops only \$1.9 million.

In 1962, the lumber and wood products industry numbered 83 firms and employed more than 1,800 persons. Marinette County with two-thirds of the subregion's \$63 million value added by manufacturing activity in 1958, has the greatest concentration of industry in the subregion. Paper and allied products comprise the single most important industry in the subregion with value added by manufacturing in 1958 totaling \$27.2 million in Mar-

inette County alone. The food and kindred products industry is the only other manufacturing activity of any significance in the subregion, its 1962 employment totaling about 500.

During the 1950 to 1960 period, the subregion was one of two in the Lake Michigan Watershed to suffer employment losses in those industry groups which are considered major water users.

During 1960, there was considerable shipping from the Menominee-Marinette Port and from the Oconto Harbor. In the Menominee Harbor district, vessel traffic totaled 595,000 tons. A small amount of the mineral, andesite, was quarried in Marinette. Sand and gravel are produced in Oconto, Forest and Marinette Counties.

Nicolet National Forest comprises two-thirds of Forest County and part of Florence County. The iron formation of the Menominee range extends into Florence County, but no mines are currently in operation.

Population of this subregion is projected at 74,000 for 2020, essentially unchanged from the present. Manufacturing output is projected to increase fourfold. Most of this is expected to result from increases in productivity during the 60 year period.

W-3, Brown, Langlade, Outagamie, Shawano, and Waupaca Counties, Wisconsin

This 3,944 square mile economic subregion constitutes the northern two-thirds of the Fox River Subbasin.

Population of this subregion totaled 316,500 in 1960 - an increase of

44,200 since 1950 and an increase of 70,200 since 1940. In 1960, approximately 66 percent of the population was municipal. Brown County, a Standard Metropolitan Statistical Area with a 1960 population of 125,000, borders on Green Bay. The City of Green Bay at the mouth of the Fox River, with a population of almost 63,000, is the subregion's major city.

The Port of Green Bay engages in world trade through the St. Lawrence Seaway, and the Fox River is navigable by shallower draft vessels to Lake Winnebago. Three major railroads service the area.

The second largest incorporated place of the subregion is Appleton City (48,000), located almost entirely in Outagamie County.

Value added by manufacture for the subregion rose from \$40 million in 1939 to \$278 million in 1958. Sales of crops totaled \$11 million in 1959, including the sales of 1.2 million bushels of corn and 29 thousand bushels of wheat.

Livestock and related products and forest products have considerable significance in the subregion. In 1959, the sales value of livestock and livestock products totaled almost \$72 million - the largest amount of any of the subregions in the Lake Michigan Watershed. In 1958, Brown County had 16 firms and Outagamie County had 18 firms in the paper and allied products industry group; the value added by manufacturing in this industry totaled \$119.1 million and employment more than 10,000. The State of Wisconsin has maintained its share of the Nation's output of paper and allied products since 1947 and in so doing has

resisted the downward trend noted in most of the Great Lakes states. However, this downward trend may be temporary; according to "Region, Resources and Economic Growth" published by Resources for the Future, the Great Lakes and upper New England states appear to be in for a reversal of trend. Low current timber cut relative to realizable growth, and a new semichemical process that allows low grade hard woods to be used for pulp indicate a revival of forest activity in these areas. Another factor pointing to a continued growth of this industry in the subregion is the considerable amount of pulpwood imported from outside of the area; thus the industry is not dependent upon local timber resources.

Next in importance was the food and kindred products industry group whose 238 firms employed 6,336 persons and created value added by manufacture of \$47.4 million in 1958. Other manufacturing industries included machinery, except electrical, and fabricated metal products.

Employment in major water-using industries increased from 17,089 to 20,647 in the 1950 to 1960 decade.

Irrigation is an important factor to the large potato crop of Langlade County. This county produced almost one-third of the state's 1959 crop of 13 million bushels.

Population of the subregion is projected to increase two and a half times to 807,000 by the year 2020. The population classified as municipal will increase from 65 to 85 percent of the total in the 60 year study period. Industrial activity is projected to increase six times by 2020 - arising

both from large increases in population and employment and from productivity increases.

W-4, Fond du Lac, Green Lake, Marquette, Waushara and Winnebago Counties, Wisconsin

This five-county economic subregion has an area of 2,618 square miles and contains the southern one-third of the Fox River Subbasin.

The 1960 population of this subregion was 220,400. Three of the counties have had continuous growth since 1940 - Fond du Lac, Green Lake, and Winnebago - the latter leading in both population and growth rate in each decade. Marquette and Waushara showed gradual declines during this period. Sixty-five percent of the 1960 population of the area was municipal. The largest cities in the subregion are: Oshkosh (45,100), Fond du Lac (29,900) and Neenah (18,000). All border on Lake Winnebago. Wisconsin State College is at Oshkosh.

The Upper Fox River flows through Green Lake and Marquette Counties. The area provides considerable attraction to tourists.

Winnebago County ranks first in the Lake Michigan Watershed in the production of paper and allied products. Value added by manufacture in this industry totaled \$81 million for Winnebago County in 1958. Approximately 6,300 persons were employed by the industry. Within the subregion, non-electrical machinery is the second most important industry. In Winnebago County this industry had a 1958 value added by manufacturing of \$17.3 million. Other subregion industries

include food and kindred products, primarily dairy products, and transportation equipment. Employment in water-using industries increased by 2,946 in the 1950 to 1960 period.

The total value of crops, livestock and livestock products sold in 1958 was \$62 million. Crops, including sales of 2.5 million bushels of corn, amounted to \$10 million; livestock and associated products totaled \$52 million. Dairying is important in this area; much of the milk is converted into cheese, butter and similar products. In this subregion, as in the entire State of Wisconsin, cheese factories are the most common type of manufacturing activity. Fond du Lac, with dairy product sales amounting to almost \$15 million in 1959, ranked first in the subregion and fifth in the state. Waushara County ranked second in the state in the number of acres irrigated with 5,238 in 1959.

The population of this subregion is projected to grow from its 1960 figure of 220,400 to 458,000 in 2020. Most of the growth will occur in urban areas and the percent of the population classified as municipal will increase to 77 percent in 2020. A six-fold increase in manufacturing output is likely over the 60 year study period. Trends in the paper industry described in W-3 apply also to W-4.

W-5, Milwaukee and Waukesha Counties, Wisconsin

This economic subregion has an area of 729 square miles. Most of Milwaukee County and the eastern portion of Waukesha County are in the Milwaukee River Basin.

The 1960 population of this subregion, which consists of Milwaukee and Waukesha Counties, was approximately 1.2 million. All of the population of Milwaukee County and 65 percent of Waukesha County is classified as municipal. Table 22 indicates the recent trends in population and how this trend compares with that of the Nation.

As indicated in Table 22, the population growth of the subregion approximately kept pace with the national growth from 1940 to 1960. More than 26 percent of the State of Wisconsin's population and 40 percent of its manufacturing employment are in Milwaukee County. Almost 75 percent of the County's population lives within the City of Milwaukee. Other large incorporated places in Milwaukee County include West Allis (68,157), Wauwatosa (56,923) and South Milwaukee (20,307). Large incorporated places in Waukesha County include Waukesha (30,004) and Brookfield City (19,812).

The subregion's industrial activity, as measured by value added by manufacture, while increasing in dollar volume declined as a percent of the Nation between 1947 and 1962 as shown in Table 22.

Of the subregion's \$1.7 billion of value added by manufacture in 1958, approximately \$1.2 billion was accounted for by the City of Milwaukee and \$170 million was accounted for by the City of West Allis. Leading industries of the area include: machinery, except electrical; food and kindred products; electrical machinery; fabricated metal products; primary metal industries; transportation equipment; and printing and publishing. Table 23

shows the 1947-1962 trends in water-using industries.

Employment in major water-using industries increased by 1,310 in the 1950 to 1960 period. This increase was considerably below the 11,205 needed to maintain the subregion's share of the national total, i.e., rate of growth in the area was not as rapid as the national rate.

Within the food and kindred products category the larger sub-categories are beverages (primarily malt liquors), meat products, and dairy products.

Milwaukee County is a major wholesale trading center. In 1963 its dollar volume of wholesale trade was approximately \$2.8 billion - more than 50 percent of the State total.

Milwaukee is a leading lake port, and this should contribute substantially to future growth of the region. A large part of port activities consists of bringing in raw materials needed in manufacturing, and coal for fuel and power. A variety of products enter into transoceanic as well as Great Lakes commerce.

Waukesha County industries include machinery, except electrical; primary metals; and food and kindred products.

This subregion's sales of crops, livestock and livestock products totaled \$21 million in 1959. Livestock and associated products accounted for \$14 million of the total, and crops for \$7 million. Much of the crops sold consisted of nursery and greenhouse products, flowers, vegetable seeds and plants, and bulbs. Sales of these

TABLE 22

Population and Value Added by Manufacture
Milwaukee Standard Metropolitan Statistical Area

Population			Value Added		
Year	(000)	% N	Year	(\$1,000)	% N
1940	829.6	.63	1947	1,013,542	1.36
1950	956.9	.63	1954	1,493,953	1.27
1960	1,194.3	.67	1958	1,722,520	1.22
			1960	1,999,818	1.22
			1962	2,107,388	1.18

Note: % N is the percent of the national total population
or value added by manufacture.

Source: 1960 Census of Population; Census of Manufactures 1954,
1958; 1962 Annual Survey of Manufactures.

TABLE 23

Value Added by Manufacture in Selected Major Water-Using Industries of the Milwaukee Standard Metropolitan Statistical Area ^{1/} 1947, 1954, 1958, and 1962

Industry	^{2/} 1947		1954		1958		1962	
	Million Dollars	^{3/} % 5 State Region	Million Dollars	^{3/} % 5 State Region	Million Dollars	^{3/} % 5 State Region	Million Dollars	^{3/} % 5 State Region
Food and Kindred Products	198.4	9.2	246.5	7.2	275.6	6.4	307.3	5.9
Paper and Allied Products	22.4	2.9	29.8	2.6	37.5	2.7	46.9	2.7
Chemicals and Allied Products	21.7	1.6	29.8	1.4	35.8	1.3	N/A	N/A
Primary Metal Industries	81.2	3.4	121.4	3.1	139.6	3.1	179.8	3.1

^{1/} Consists of Milwaukee and Waukesha Counties, Wisconsin.

^{2/} Estimated as industry data not available for Waukesha County.

^{3/} Consists of Illinois, Indiana, Michigan, Ohio, and Wisconsin.

Source: Census of Manufactures 1954, 1958;
1962 Annual Survey of Manufactures.

products were almost \$4 million in 1959.

This subregion's population is projected to increase to 2,990,000 by the year 2020. By that year substantially all of the population will be municipal. Manufacturing output is projected to increase sixfold by the year 2020.

W-6, Ozaukee, Sheboygan and Washington Counties, Wisconsin

This three-county subregion is 1,169 square miles in area. Washington and Ozaukee Counties are primarily in the Milwaukee River Basin and the major portion of Sheboygan County is in the Sheboygan River Basin.

The 1960 population of this subregion which is immediately north of the Milwaukee area, was 171,000 of which 60 percent was municipal. The region increased in population by 33,000 since 1950. The largest city in this subregion is Sheboygan (46,000).

Value added by manufacture for the subregion in 1958 was \$203 million. The most important area industry, as measured by value added by manufacturing in 1958, was nonelectrical machinery valued at \$46.8 million. Other industries and their 1958 value added by manufacturing amounts are: food and kindred products \$28.6 million, fabricated metal products \$24.8 million, and furniture and fixtures \$9.9 million.

Employment in major water-using industries totaled 15,446 in 1960, an increase of 1,647 over 1950.

Of the nearly \$35 million sales of

livestock and related products in this subregion in 1959, the largest segment was from dairy products which totaled \$23 million. The 1959 value of crops sold was \$5.2 million.

The 1960 mineral activity, mainly in sand, gravel and limestone, totaled over \$1 million.

This subregion's several public hunting and fishing grounds, state parks and forests are recreational advantages.

Sheboygan, on the western shore of Lake Michigan is served by rail, highway and water transportation. The Port Washington Harbor domestic tonnage, mostly coal and petroleum, amounts to approximately 500,000 tons per year. The Sheboygan Harbor handles a comparable traffic volume.

Total population is projected at 415,000 for 2020 and municipal population is projected at 326,000 in that year. Value added by manufacture is projected to increase by a factor of six.

W-7, Calumet, Door, Kewaunee, and Manitowoc Counties, Wisconsin

This subregion extends eastward from Lake Winnebago to the shore of Lake Michigan and northward along the Door Peninsula. The subregion includes the Sheboygan and Manitowoc River Basins and the Sturgeon Bay Area.

The 1960 population of this subregion was 136,500 of which 54 percent was municipal. The largest cities are Manitowoc (32,275) and Sturgeon Bay (7,300).

Of the \$134 million in value added by manufacture in the subregion during 1958, industry in Manitowoc County accounted for \$94 million. Food and kindred products is the primary industry in this subregion, with value added by manufacture in 1958 of \$16.2 million in Manitowoc County alone. Other important industries in the subregion and their 1958 values added by manufacture are: machinery, except electrical \$14.8 million; electrical machinery \$9.3 million; and transportation equipment, primarily shipbuilding, \$4.8 million.

Major water-using industries increased their employment to 10,926 in the 1950 to 1960 decade.

Agriculture is important to the area. Crop sales in 1959 amounted to \$7 million, almost half of it from sales of fruit and nuts. Door County, located on the peninsula between Green Bay and Lake Michigan, produced 97 percent of the state's 1959 cherry crop of 22 million pounds. Almost \$44 million resulted from the sale of livestock and livestock products in 1959. Mineral production, including cement, clays, limestone, sand and gravel, is substantial in Manitowoc County.

There are three harbors in the subregion: Manitowoc, Sturgeon Bay, and Kewaunee. The Sturgeon Bay-Lake Michigan Canal through Door County facilitates ship movement between Green Bay and Lake Michigan.

Recreational facilities are economically important and there are large state investments in new and expanded outdoor recreation.

Population is projected to approximately double in the 60-year study period. The expected total of 257,000 will be 72 percent municipal. Manufacturing output is projected to increase fivefold by 2020.

M-1, Delta, Dickinson, Iron and Menominee Counties, Michigan

With an area of 4,166 square miles this is the largest of the 19 designated subregions in the Lake Michigan Watershed. It extends around and inland from the northwestern shore of Lake Michigan.

The 1960 population of this subregion was 100,100, a decrease of 600 from the 1950 total. The principal cities in the area and their 1960 population are: Escanaba (15,391) and Menominee (11,289).

Value added by manufacture in the subregion in 1958 totaled \$48.3 million. In 1958, 85 percent of the subregion's land area was forest and the significant industries of the area all utilize wood products as a raw material. These activities include: lumber and wood products; furniture and fixtures; and paper and allied products.

Industries considered as major water users employed 3,390 persons in 1960.

Value of mineral production in this subregion, which totaled over \$22 million in 1959, was greater than that of any of the other subregions of the Lake Michigan Watershed. In 1959, iron ore production was valued at \$18.9 million in Iron County. In 1962, the Escanaba harbor facilities handled 5.8

million tons of freight, including 5.4 million tons of iron ore and concentrates.

The total value of crops, livestock and livestock products sold was \$8.7 million in 1959. Crops accounted for \$1.8 million of the total and livestock and associated products \$6.9 million. Menominee County, the southernmost in the subregion, was responsible for almost 50 percent of the total agricultural output. Sales of corn and wheat in 1959 were negligible.

No growth in population is projected for this economic subregion. A four- to fivefold increase in value added by manufacture is seen by the year 2020, arising from productivity increases.

M-2, Antrim, Charlevoix, Emmet, Leelanau, Mackinac, and Schoolcraft Counties, Michigan

This six-county subregion extends around the northeastern shore of Lake Michigan.

Its population in 1960 was 68,900 - only slightly higher than in 1940 and substantially less than the 1910 population of 82,000. All of the counties border on Lake Michigan. Substantially a rural subregion, Petoskey with a 1960 population of 6,100 is the largest city. Forty percent of the 1960 population of the subregion was municipal.

As in other subregions located in the northern portion of the Watershed, the most significant factor in this subregion's economy is its large percentage of forest land. The subregion

as a whole has 79 percent of its land area in forest; the individual counties range from 58 percent in Leelanau to about 90 percent in Mackinac. Forest products are important to manufacturing in this subregion. In 1958, 88 of the area's 165 manufacturing firms used wood as a raw material.

Employment in major water-using industries increased by 503 to 2,008 in the 1950 to 1960 period.

Much of the area's soil is sandy and not conducive to agriculture production. Sales of crops, livestock and livestock products were \$10.0 million in 1959. Crops sold totaled \$4.4 million and livestock and livestock products amounted to \$5.6 million. Leelanau County ranked third in the state in production of sour cherries, with a 1959 crop of 23 million pounds.

The tourist industry contributes substantially to the local economy.

The population of this subregion is projected to remain approximately at the present level. Industrial activity is projected to increase sevenfold by the year 2020.

M-3, Grand Traverse and Kalkaska Counties, Michigan

This two-county subregion has one-half of its area in the Grand Traverse and Little Traverse Bay areas and the other half in the Manistee River Basin.

The 1960 population of this subregion was approximately 38,000 - an increase of 10,000 since 1940. Almost 33,500 of the total population live in

Grand Traverse County. Traverse City had a 1960 population of 18,432.

Manufacturing employment totaled about 2,200 in 1958, primarily centered in the food and kindred products and machinery, except electrical, industry groups. Value added by manufacture totaled \$14.5 million in 1958. Small quantities of petroleum and natural gas are produced in Kalkaska County.

Traverse City borders on Grand Traverse Bay and the tourist industry is important to the local economy. In 1958, 82 percent of Kalkaska County was in forest.

The subregional sales of crops, livestock and livestock products totaled \$6.0 million in 1959. Sales of livestock were \$2.2 million and sales of crops were \$3.8 million. Grand Traverse led the state in the production of sour cherries with a 1959 crop of 29.3 million pounds.

The population of this subregion is projected to increase to 61,000 by 2020. All of the growth will be in municipal population. Manufacturing output is projected to increase to more than five times the 1960 level by 2020.

M-4, Benzie, Manistee and Wexford Counties, Michigan

This subregion contains parts of two river basins, the Betsie and the Manistee.

Its population of 45,300 in 1960 was essentially the same as in 1940. Its two largest cities are Cadillac (10,112) and Manistee (8,324). Benzie

and Manistee Counties border on the western shore of Lake Michigan.

Employment in manufacturing declined from 5,098 in 1947 to 3,783 in 1958 and employment in major water-using industries declined by 503 in the 1950 to 1960 period. Value added by manufacture, however, increased from 1947 to 1954 and remained relatively constant from 1954 to 1958. Major manufacturing activities included chemicals and allied products, transportation equipment, and paper and allied products,

Production of minerals in Manistee County in a recent year totaled \$12.5 million, including salt, magnesium compounds, bromine, and sand and gravel.

This subregion had sales of crops, livestock and livestock products totaling \$5.7 million in 1959, the former valued at \$3.7 million, the latter at \$2.0 million. Fruit production was substantial for these two lakeside counties.

The population of this subregion is projected to increase to 50,000 by the year 2020. Value added by manufacture is projected to increase fourfold.

M-5, Clare, Mecosta, Missaukee, Osceola and Roscommon Counties, Michigan

This 2,802 square mile subregion is a part of the Muskegon River Basin.

Its 1960 population of 60,300 represented an increase of 9,200 over the 1940 population, but was only 800 more than the 1910 population. Approximately 39 percent of the population is

municipal. The largest city is Big Rapids, population 8,687.

Only a small amount of manufacturing activity takes place in the area, adding \$16.8 million to the 1958 economy.

However, employment in water-using industries doubled to 2,035 in the 1950 to 1960 decade.

Value of crops sold in 1959 totaled less than \$3 million; value of livestock and livestock products sold totaled \$11.7 million. Much of the area is cutover timberland and much of the soil is sandy loam of low fertility.

Value of mineral production totaled \$6.3 million in 1959. Most of this was in petroleum and natural gas. Osceola County ranked second in the state in the production of natural gas.

This subregion's population is projected to increase to 78,000 by 2020. An approximate sixfold increase in manufacturing output is seen by the year 2020.

M-6, Lake, Mason, Muskegon, Newaygo, and Oceana Counties, Michigan

This five-county subregion had a 1960 population of 217,800. Three of the five counties, Mason, Oceana and Muskegon, border the western shore of Lake Michigan. Muskegon County population in 1960 was approximately 150,000. Paralleling the national growth rate the subregion increased in population by 65,000 since 1940. Major cities of the area include Muskegon, Muskegon Heights, North Muskegon and Ludington.

Manufacturing employment declined from approximately 34,000 to 27,600 between 1947 and 1954, but remained relatively constant between 1954 and 1958. Those industries considered major water users, however, increased employment by 5,784 between 1950 and 1960. Value added by manufacture declined, as a percent of the Nation between 1947 and 1958. Major industries in the area are machinery, except electrical, and primary metals, the latter concentrated in Muskegon County. Other significant industries are furniture and fixtures, food and kindred products, and chemicals and allied products.

Value of crops and livestock and livestock products sold in 1959 totaled \$23 million, divided about equally between the two. Oceana County was second in the state in production of sour cherries with a 1959 crop total of 29.1 million pounds.

Sand, gravel, salt, petroleum and natural gas are produced in the area but not in large quantities.

Generally the area has excellent recreational resources and recreational activities are important to the area economy.

Muskegon's harbor facilities handled over 3.5 million tons of a wide range of commodities during 1960.

The population of this area is projected to be 395,000 in the year 2020. Sixty-six percent of the total population will be municipal. Manufacturing output is projected to increase to a level five times that of 1960.

M-7, Barry, Kent and Ottawa Counties,
Michigan

This economic subregion constitutes the western one-third of the Grand River Subbasin. The southern portion of Ottawa County is coextensive with the Black River Basin. Part of the region is located on the western shore of Lake Michigan.

This subregion had a 1960 population of 493,600 of which 72 percent was municipal. Kent County (the Grand Rapids Standard Metropolitan Statistical Area) had a 1960 population of 363,200. Between 1940 and 1960, this three-county area increased in population by 165,000 and is growing at a rate exceeding the national average. Major cities include Grand Rapids (173,313), Wyoming (45,829), East Grand Rapids (10,924), Grand Haven (11,066) and Holland (24,777, of which 22,140 is in Ottawa County).

Value added by manufacture, which totaled \$569 million in 1958, increased as a percent of the Nation from .433 in 1939 to .480 in 1954 but declined to .403 in 1958. Manufacturing employment decreased between 1954 and 1958 from 66,400 to 58,700. An increase of 8,284 in employment in industries considered to be major water users took place in the 1950 to 1960 period. Of the \$569 million of value added by manufacture in 1958, \$410 million was accounted for by Kent County and \$138 million by Ottawa County. Major industrial activities include fabricated metals (the largest industry group), furniture and fixtures, machinery, except electrical, electrical machinery, and food and kindred products. Other industries are significant and the area is consider-

ably diversified.

During 1959, the value of livestock and livestock products sold totaled \$25 million and the value of crops sold totaled \$16 million. Dairying is important in this subregion and Kent County, which includes the Grand Rapids milkshed, had sales of dairy products in 1959 of \$4.7 million. Kent also had a 1959 crop of 1.6 million bushels of apples. Subregion sales of corn were 1.6 million bushels and wheat sales were 1.6 million bushels.

Grand Rapids is also a wholesale supply center for much of the Lower Peninsula. In 1963, wholesale trade in the subregion totaled more than \$1 billion.

Population is projected to be 1,098,000 in 2020. Municipal population is projected to be 988,000 in that year. Industrial activity is projected to increase sixfold.

M-8, Clinton, Eaton, Gratiot, Ingham,
Ionia, Montcalm and Shiawassee Counties,
Michigan

This seven-county subregion comprises two-thirds of the Grand River Basin. With an area of 4,090 square miles, it is the second largest economic subregion in the watershed.

Its 1960 population of 468,300 was 62 percent municipal. Ingham County, the site of the State Capital, had a 1960 population of 211,300. Populations of the other five counties range from 37,000 to 53,000. The counties vary considerably as to their extent of municipal population, e.g., Ingham County, 82 percent, and Clinton County, 30 percent. Of the six counties

only Ingham County had cities over 10,000 namely, Lansing (107,800) and East Lansing (30,198). Michigan State University at East Lansing contributes substantially to the population total. Since 1940 the subregion has grown more rapidly than the Nation as a whole, increasing by almost 140,000 since that year.

Manufacturing employment declined between 1947 and 1958 from 43,100 to 39,100. Employment in water-using industries increased by 4,557 from 1950 to 1960. Value added by manufacture, while increasing as a percent of the Nation and in dollar volume (current dollars) from 1947 to 1954, declined slightly in dollar volume and as a percent of the Nation from 1954 to 1958 when it totaled \$417 million. About 62 percent of the total industrial activity is located in Ingham County. Although several industries are significant in the area, the major industrial activity involves the category transportation equipment, primary motor vehicles and equipment. Most of this activity within the subregion is centered in Ingham County.

In 1958, wholesale trade in the subregion totaled \$433 million, value of crops sold totaled \$43 million and value of livestock and livestock products sold, \$57 million.

This subregion, like M-5, is too far from the Lake to have extensive fruit farming, but is far enough south to have a sufficiently long growing season to permit corn to ripen. This subregion had sales of corn of 8.8 million bushels and sales of wheat of 7.6 million bushels in 1959. The urban areas which surround this subregion on three sides provide a large

market for dairy products, the subregion's sales totaling \$28.5 million in 1959.

The subregion's population is projected to increase to 1,231,000 by the year 2020. Of the total, 85 percent will be municipal. Value added by manufacture is projected to increase sevenfold in the 60-year study period.

M-9, Allegan, Calhoun, Jackson, Kalamazoo and Van Buren Counties, Michigan

This five-county, 3,417 square-mile, subregion coincides approximately with the Kalamazoo River Basin. Jackson County is primarily in the Grand River Basin.

This subregion, which has two of its counties bordering on Lake Michigan, had a 1960 population of 547,000. Two standard metropolitan areas exist within the region, namely Kalamazoo and Jackson. Sixty-five percent of the population was municipal with a higher percentage existing in the more industrialized counties. Major cities include Kalamazoo (82,089), Jackson (50,720) and Battle Creek (44,169). Except in the 1930-1940 period, the area has grown rapidly and steadily since 1910. Since 1940 there has been an increase in population of 182,000.

Manufacturing employment in this subregion grew more rapidly than that of the Nation between 1947 and 1958, but remained relatively constant in total numbers between 1954 and 1958. Manufacturing employment in major water-using industries increased by 6,233 in the 1950 to 1960 period to a total of 17,227. Major industries of the area include food and kindred products, primarily cereal preparation in

Calhoun County; paper and allied products, primarily Kalamazoo County; fabricated metals; machinery except electrical; transportation equipment; and chemical and allied products. The subregion is highly diversified industrially.

Value added by manufacture in the subregion totaled \$760 million in 1958 - a larger amount than in 1954 when it totaled \$651 million, but slightly smaller as a percent of the Nation's total.

Agriculturally, the subregion ranks high in the Watershed, with crops and livestock and livestock products valued at \$34 million and \$38 million, respectively. Corn sales were 5.1 million bushels and wheat sales were 3.1 million in 1959. Van Buren County ranks high in the state in production of fruit, especially apples and grapes.

Population is projected to increase from its present 546,700 to 1,058,000 in 2020, and 79 percent will be municipal. Industrial activity is projected to increase five- to sixfold in the 60-year study period.

M-10, Berrien, Branch, Cass, and St. Joseph Counties, Michigan

This subregion constitutes the Michigan portion of the St. Joseph River Basin near the southern Michigan border.

These four counties had a 1960 population of 264,000. Berrien County, bordering Lake Michigan, accounted for 150,000 of this total. The area population has grown rapidly during the past 20 years, exceeding the national

growth rate. There are three cities of over 10,000 population, all located in Berrien County. They are Benton Harbor (19,136), Niles (13,842) and St. Joseph (11,755).

Compared with the national growth rate, manufacturing employment of this subregion has fared well, increasing since 1947 both as a percent of the Nation and in absolute numbers. In 1958, value added by manufacture totaled \$289 million of which Berrien County accounted for \$182 million. Industrial activity in the area is considerably diversified, the leading industries being primary metals, electrical machinery, paper and allied products, and transportation equipment.

The 1959 total value of crops, livestock and livestock products was \$55 million. Crops accounted for \$33 million of the total and livestock and their products for \$22 million. Fruit growing, centered in Berrien County, is the single most important agricultural activity in the subregion. In the whole Watershed, Berrien ranks first in the production of apples, peaches, pears, grapes, strawberries and raspberries. In 1959, the sales of these fruits totaled more than \$15 million. In addition, Berrien led the Watershed in the number of irrigated acres with 7,125 in 1959.

This subregion's population is projected to more than double to 566,000 by 2020. Of the total, 370,000 will be municipal. Manufacturing output is projected to be more than five times the 1960 level.

IND-1, Lake and Porter Counties,
Indiana

The 1960 population of this subregion, which is in northwest Indiana and contiguous with the Chicago Standard Metropolitan Statistical Area, was 573,600. Of this, 513,300 was in Lake County. The area is highly urbanized, being almost 90 percent municipal in 1960. Population has increased rapidly in recent decades - by 87,000 between 1940 and 1950, or 27 percent, and by 165,000 between 1950 and 1960, or 40 percent.

Value added by manufacture in 1958 totaled approximately \$1.3 billion. Almost \$800 million, or about 60 percent of the total, represents value added by the primary metal industry - almost all steel rolling and finishing. The primary metal industry in this subregion not only increased in absolute amount between 1947 and 1958, but also relatively with respect to the Nation; in 1947 the area accounted for 5.7 percent of the Nation's total of this industry and in 1958 it accounted for 6.8 percent. Other significant industries in the area are petroleum and coal products, chemical and allied products, fabricated metal products, and food and kindred products. Of the \$1.3 billion of value added in 1958 the City of East Chicago accounted for \$550 million, Gary for \$450 million and Hammond for \$150 million. All three cities are in Lake County. Tables 24 and 25 summarize population and total value added by manufacturing trends in the area. Agricultural activity is not economically significant in this highly industrialized subregion. The combined value of crops, livestock and livestock products sold in 1959, totaled

\$24.9 million. The total includes \$13.1 million from the sale of crops and \$11.9 million from the sale of livestock and livestock products.

Population of this subregion is projected to be 1.7 million (all municipal) by the year 2020. This growth rate is less than that of 1940-1960, but greater than the likely national growth rate. Also, it is slightly lower than local estimate extension for the 1960-1980 period. Industrial expansion, especially in the primary metal industries, is likely to continue at least as rapidly as in the Nation. From 1947 to 1958 the rate of growth exceeded that of the Nation.

The primary metals manufacturing industries, and especially the steel industry of the Chicago-Northwestern Indiana Standard Consolidated Area, have recently been greatly expanded and plans for the near future indicate a continued significant expansion of the industry. The Chicago region, extending into the four states surrounding Chicago, is a deficit area with regard to steel production. The new facilities will embrace the modern production techniques. The principal new plants are in Porter County, Indiana. The machinery and metal products industries of this subregion may be expected to expand further with the increased availability of local producer markets and of steel in greater amount and variety.

This economic region is partially in the Illinois River Basin.

TABLE 24
Subregion IND-1
Dollar Value Added by Manufacture

Industry Group	1947 ^{1/}		1954		1958		1960	
	Subregion (000)	% N ^{2/}	Subregion (000)	% N ^{2/}	Subregion (000)	% N ^{2/}	Subregion (000)	% N ^{2/}
Food and Kindred Products	20,561	.24	35,065	.30	55,716	.32	55,840	.28
Chemicals and Allied Products	53,439	1.00	49,540	.52	111,306	.90	121,048	.84
Primary Metal Industries	330,039	5.70	590,062	5.90	797,638	6.80	827,346	6.21
Fabricated Metal Products	28,670	.58	72,536	.92	87,292	.92	112,618	1.09

^{1/} Excludes Porter County which is less than 2% of IND-1 value added.
^{2/} % N is the percent of the Nation's total of specified industry.

Source: Bureau of Census. 1954 Census of Manufactures, Volume III;
1958 Census of Manufactures; 1960 Annual Survey of Manufactures, Part 3.

TABLE 25

Population and Value Added by Manufacture
 Gary-Hammond-East Chicago
 Standard Metropolitan Statistical Area

Population			Value Added		
<u>Year</u>	<u>(000)</u>	<u>$\frac{1}{\% \text{ N}}$</u>	<u>Year</u>	<u>(000)</u>	<u>$\frac{1}{\% \text{ N}}$</u>
1940	321.0	.243	1947	597,816	.805
1950	408.2	.270	1954	980,872	.836
1960	573.5	.320	1958	1,281,927	.906
			1960	1,418,660	.869

1/ Percent of nation's total population or total value added by manufacture.

Source: U. S. Census of Population 1960,
 U. S. Census of Manufactures 1954, 1958,
 1960 Annual Survey of Manufactures.

IND-3, Elkhart, Kosciusko, LaGrange,
Noble, St. Joseph and Steuben Counties,
Indiana

The six-county subregion has an area of 2,572 square miles. It is located near the northern Indiana border in the St. Joseph River Basin.

In 1960, the population of this subregion was 448,600. The municipal population was 300,400 or 67 percent of the total. Except for the 1930-1940 decade, the area has grown rapidly and steadily since 1910; between 1950 and 1960 the population increased by 68,000. Major cities are South Bend (132,445), Mishawaka (33,361), Elkhart (40,274) and Goshen (13,718). The University of Notre Dame enrollment contributes significantly to the population of St. Joseph County. The region grew more rapidly in population than the Nation as a whole between 1940 and 1950 and grew at the same rate as the Nation between 1950 and 1960.

As a percent of the Nation, manufacturing employment declined from 1947 to 1954 and again from 1954 to 1958; value added by manufacture declined as a percent of the Nation from 1947 to 1954 but increased from 1954 to 1958. Employment in major water use industries totaled 26,208 in 1960.

St. Joseph County accounted for more than half of the value added by manufacture in the subregion in 1958, Elkhart County also has substantial manufacturing activity. Major industries of the subregion include rubber and plastic products, machinery except electrical, transportation equipment, and fabricated metal products. Other

significant industries also exist in the area, including chemical plants in Elkhart County.

In 1959, the subregion accounted for \$23 million in crops sold and \$59 million in value of livestock and livestock products sold. Crops sold included 2.8 million bushels of wheat and 8.2 million bushels of corn.

Population is projected to grow to 1,229,000 by 2020. Of the total, 84 percent is projected to be municipal. Industrial activity is projected to increase almost sevenfold.

W-1, Walworth, Racine, and Kenosha
Counties, Wisconsin

The 1960 population of this subregion, which is west and south of the Milwaukee Standard Metropolitan Area, was 294,600. About two-thirds of this population was municipal. Racine County, which is contiguous with Milwaukee County, had the largest population of this three-county area, 142,000 in 1960. Racine and Kenosha Counties are each classified as Standard Metropolitan Statistical Areas. The subregion has grown steadily in population since 1910 and rapidly during the past decade, 68,400 between 1950 and 1960, or 30 percent.

In 1958, value added by manufacture totaled \$406 million. The greater concentrations of manufacturing activity were in Racine County (\$210 million) and in Kenosha County (\$163 million). Leading industries in Racine County are machinery except electrical, and fabricated metal products. Other industries include primary metal industries and electrical machinery.

Leading industries in Kenosha County include transportation equipment, furniture and fixtures, and primary metal industries. Other industries include fabricated metal products and machinery except electrical.

Between 1947 and 1954 this subregion's share of the Nation's total value added by manufacture declined from .32 to .29 percent. Between 1954 and 1958 the subregion grew at the same rate as the Nation.

Dairying is the most important agricultural activity in this subregion. Sales of milk and cream in 1959 were \$19.9 million. The combined value of crops, livestock and livestock products was \$42.1 million in 1959. Sales of vegetables totaled almost \$1.7 million.

Population for the year 2020 is projected at 775,000, and will be all municipal by that date. The total population projection is an extension of projections made for constituent counties to the year 2000 by the Wisconsin Department of Resource Development. This rate of growth approximates the 1940-1960 growth rate to 1980 but tapers off from 1980 to 2020. An industry expansion factor of six for 2010 is projected. This economic subregion is partially in the Illinois River Basin.

SUMMARY OF PROJECTIONS

Tables 20 and 21 summarize projection of population and projections of economic activity represented by employment equivalents (employment multiplied by a general productivity factor). These two tables are utilized in projecting municipal and industrial water use.

Although some of the tables in this report, as well as some of the textual pages, were not used directly in formulating projections of municipal and industrial water use they were of value in making judgments concerning growth of subregions and subbasins and in describing specific subbasin problems and required programs.